

# Inter-comparison between the Aerosol Products Derived from Aura/OMI and Aqua/MODIS

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20771

# Issues on Aerosol Retrievals from Satellites

- Cloud-Screening (Myhre et al., 2004; Jeong and Li, 2005; Jeong et al., 2005; Remer et al., 2006; ...)
- Aerosol Optical Property Models Employed in the Retrieval Algorithms (Jeong et al., 2005)
- Differences in sampling time/footprints
- Radiometric Calibration, ...

- Synergy by Merging Multiple Products (Sat.+In-situ+Grnd.)
  - ✓ More spatial and temporal coverage (e.g. construct long-term CDR, cover different stages of a diurnal cycle, ...)
  - ✓ Value-Added Information (e.g., aerosol type determination, absorption and hygroscopic properties, ...)
  - ✓ Construct 3-Dimensional distribution

→ This study is a pilot investigation to validate respective retrieval algorithms.

# Data

## ❖ Aura/OMI

- OMAERUV L2G
  - ✓ 0.25x0.25degree in latitude and longitude resolution
- Level 3-like data (Monthly)
  - ✓ Derived from L2G data with Algorithm Flag of 0 (Defined as pixels with "Reliable AOD and AAOD")
  - ✓ 1.0x1.0degree in latitude and longitude resolution
- OMAERUV Level 2
  - ✓ 13x24km at nadir

## ❖ Aqua/MODIS

- MYD08\_M3 (Monthly)
  - ✓ 1x1degree in latitude and longitude resolution
- MYD04\_L2 (Level 2)
  - ✓ 10x10km resolution at nadir
  - ✓ Ocean, Dark Target (Land), and Deep Blue (arid-/semi-arid land)

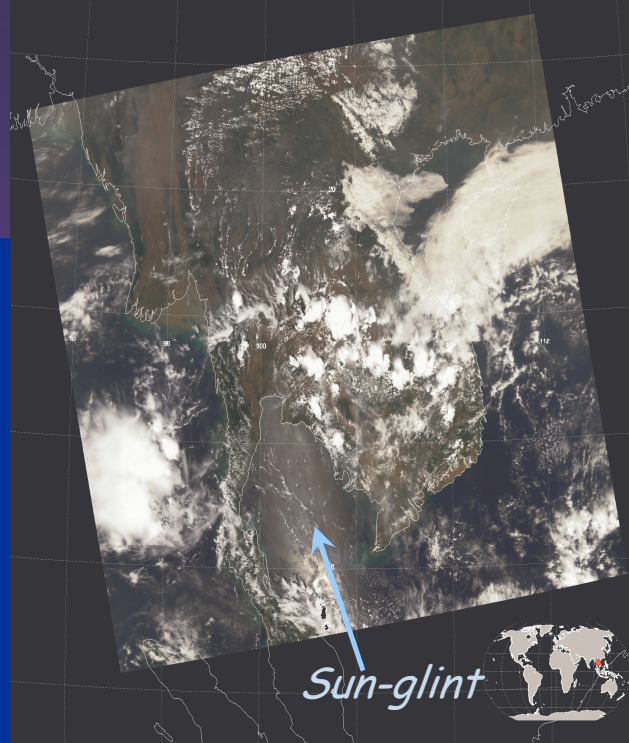
## ❖ Data Match-up Method

- A MODIS pixel nearest to an OMI pixel was picked up for inter-comparison.

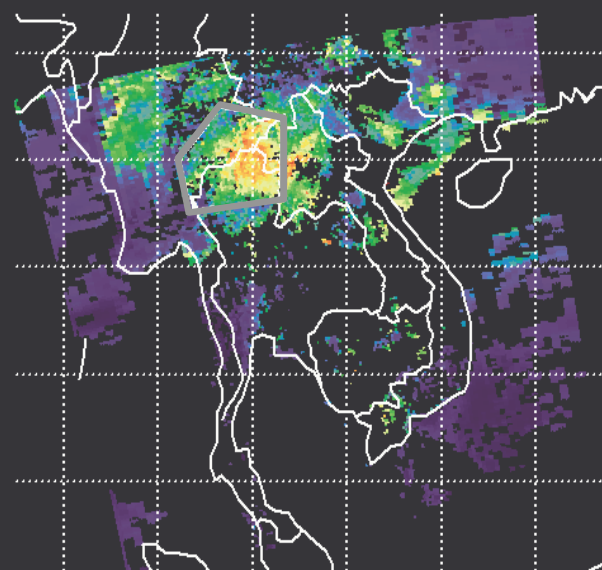
# Case 1. Southeast Asian Smoke

## MODIS RGB Image

MYD021KM A2006087.0630.004.200608071330.tif  
 Aqua MODIS True Color Image  
 Y2006, DoY087, 06:30UTC

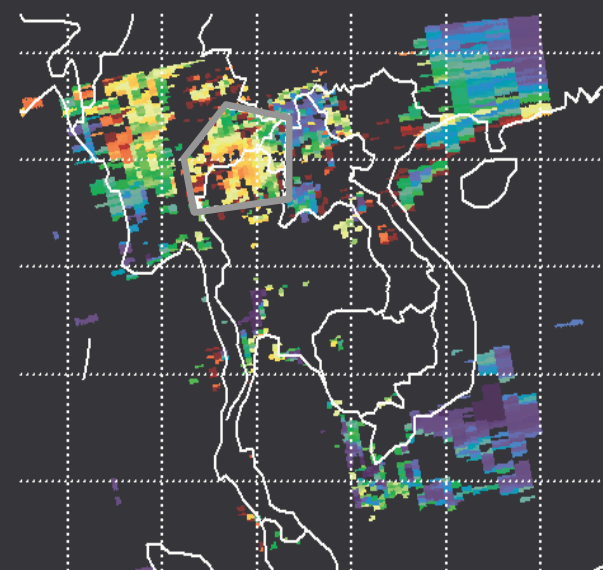


## MODIS AOT (550nm)



## OMI AOT (500nm)

Algor. Flag=0,1,2



- Biomass burning smoke spreads over Thailand, Myanmar, Laos and China
- MODIS and OMI AOT show similar patterns.
- Discrepancy where small-scale clouds population is high.

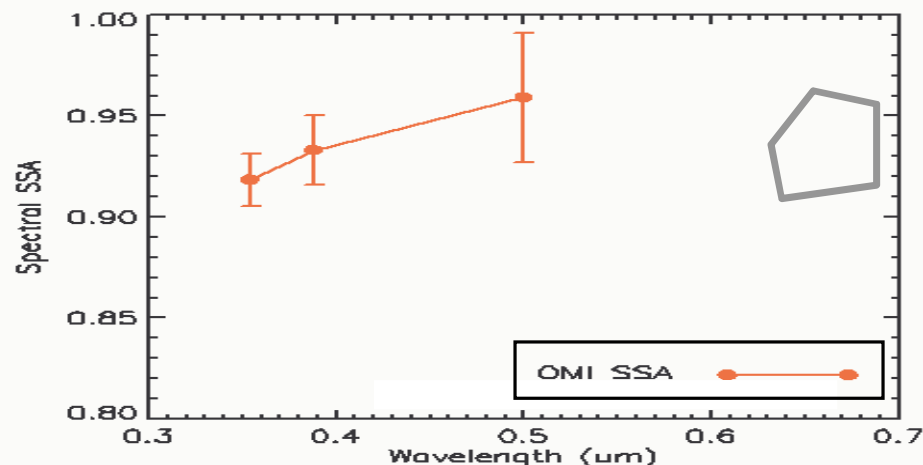
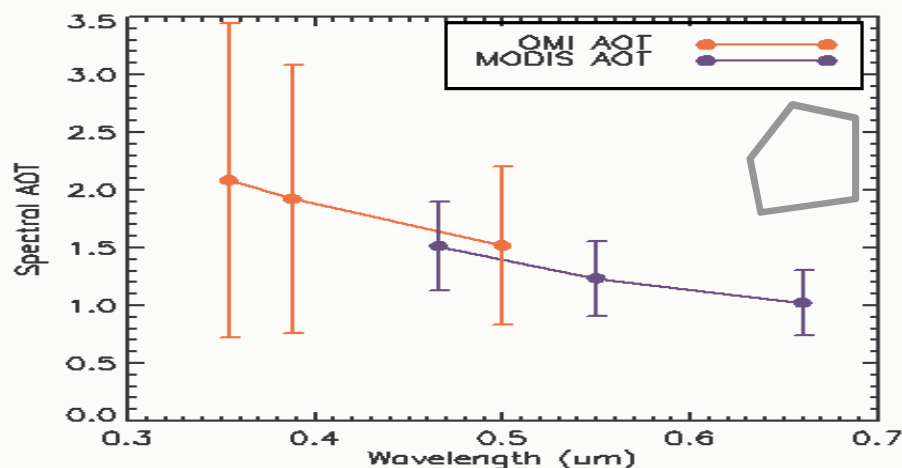
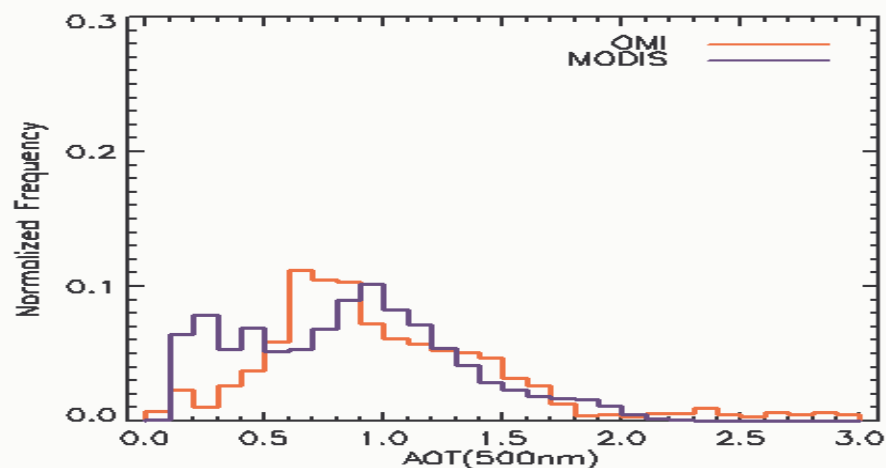
\*MODIS AOT(550nm) map shown above is composite of Dark Target and Ocean retrieval.



## Southeast Asian Smoke (Continued)

- AOT Histogram for the Entire Granule:

- ✓ Similar distribution ( $AOT > 1$ ).
- ✓ OMI has slightly lower median, lower frequency for  $AOT < 0.5$ , and slightly higher frequency for  $AOT > 2$

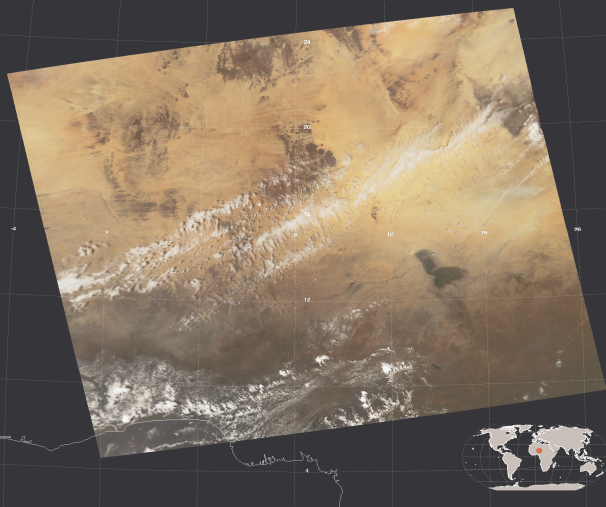


- Spectral AOT for Selected Area
  - ✓ Similar spectral dependency throughout UV/Visible spectra → Consistency between OMI and MODIS in terms of spectral signature.
- Spectral SSA for Selected Area
  - ✓ SSA increasing with wavelength ( $\lambda < 500\text{nm}$ )

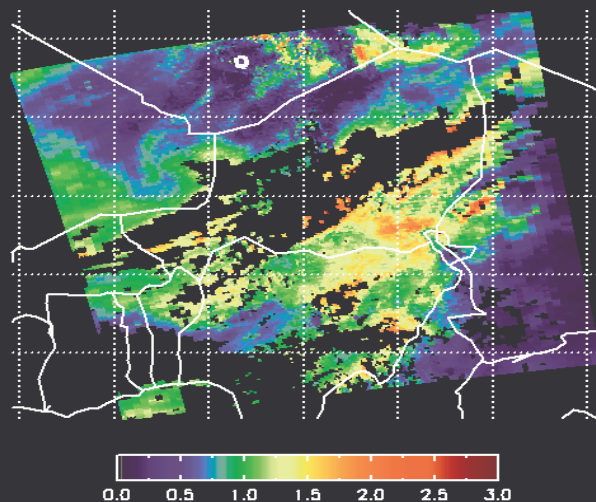
## Case 2. Saharan Dust: Near Source Region

### MODIS RGB

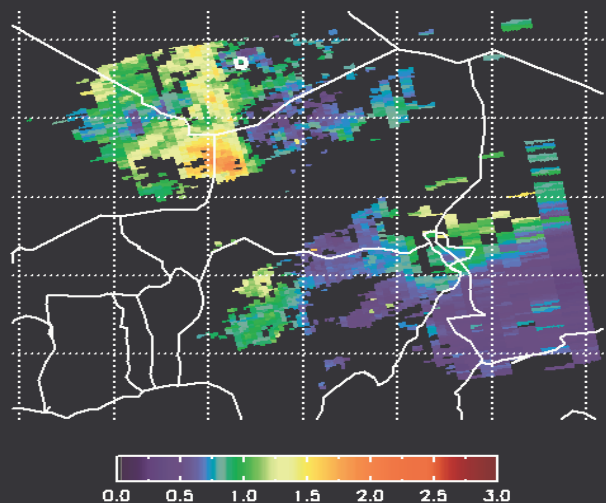
MYD021KM.A2007069.1250.005.2007070175841.hdf  
Aqua MODIS Truecolor Scene



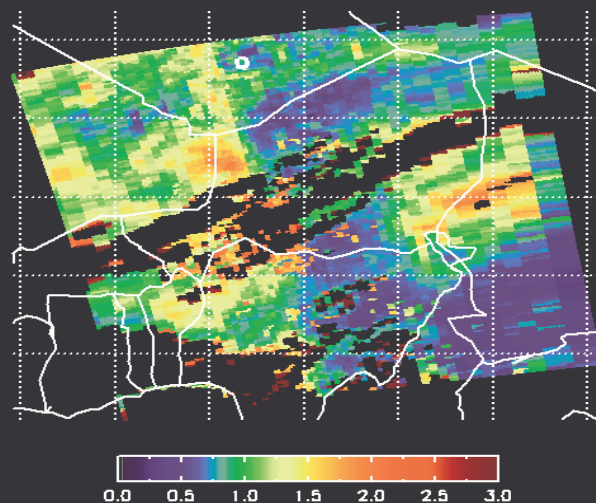
### MODIS Composite



### OMI AOT: Algor.Flag=0



### OMI AOT: Algor.Flag=0,1,2



- Both MODIS and OMI AOT captured dust outbreak at Lake Chad.
- Both products show similar AOT distributions.
- In OMI AOT with only "0" Algorithm Flag, clouds are successfully screened out, but the dust storm at the source is also screened out.

### OMI Aerosol Retrieval Algorithm Flags (AF)

- **AF=0: Reliable AOD and AAOD**
- **AF=1: Reliable AAOD**
- **AF=2: Less Reliable AOD and AAOD**

\*MODIS AOT(550nm) map shown above is composite of Deep Blue, Dark Target, and Ocean retrieval.

## Saharan Dust: Near Source Region (continued)

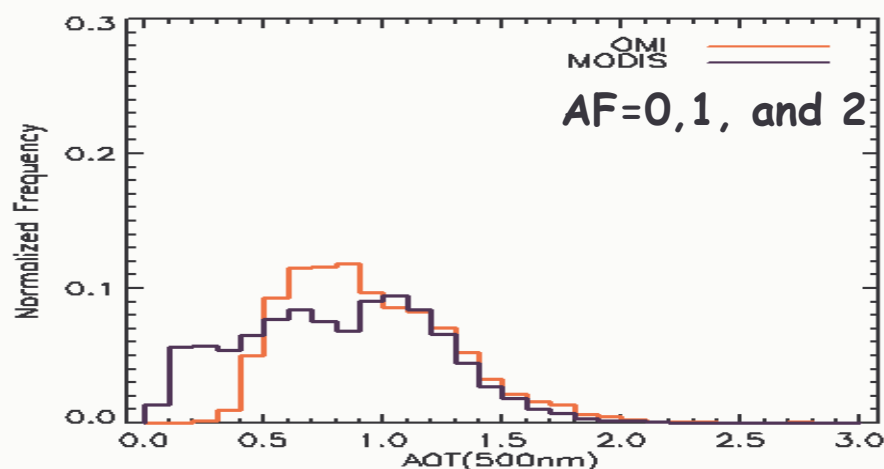
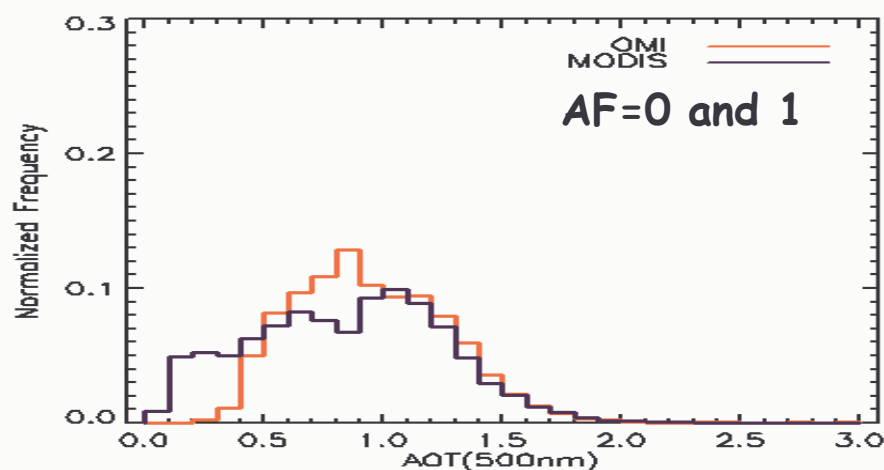
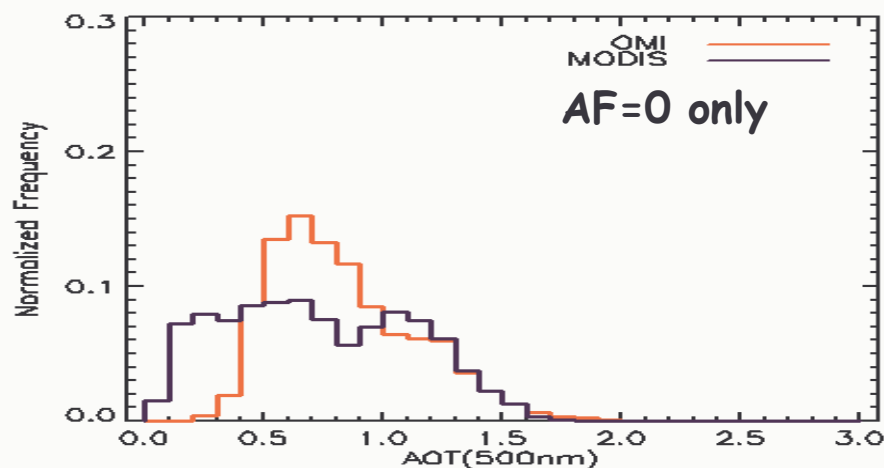
### Granule Statistics Summary

- Histograms for OMI and MODIS AOT showed similar distributions for the three different AF criteria.

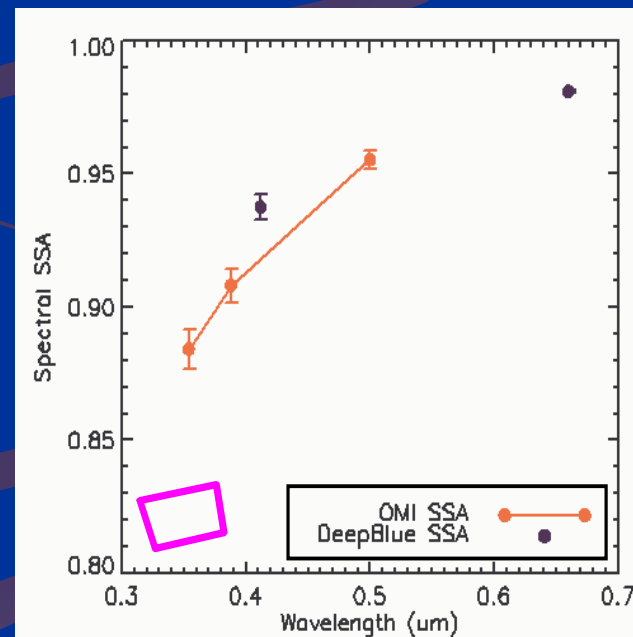
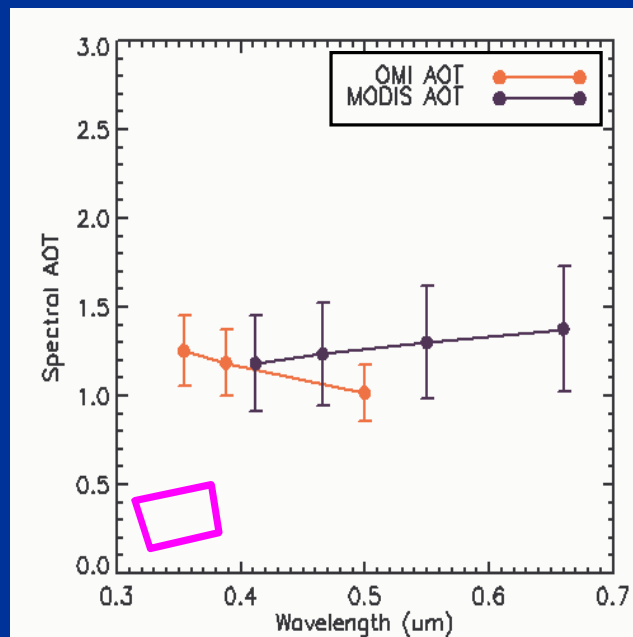
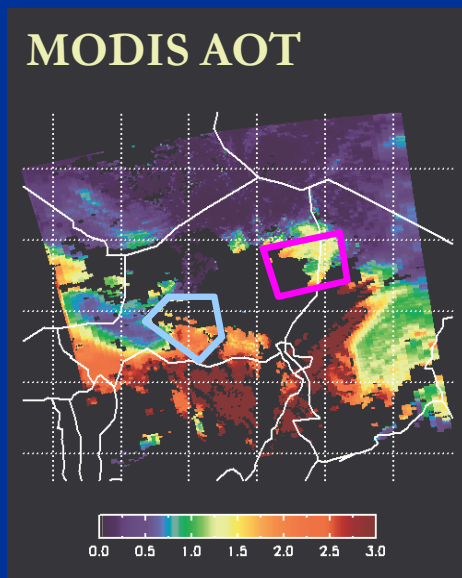
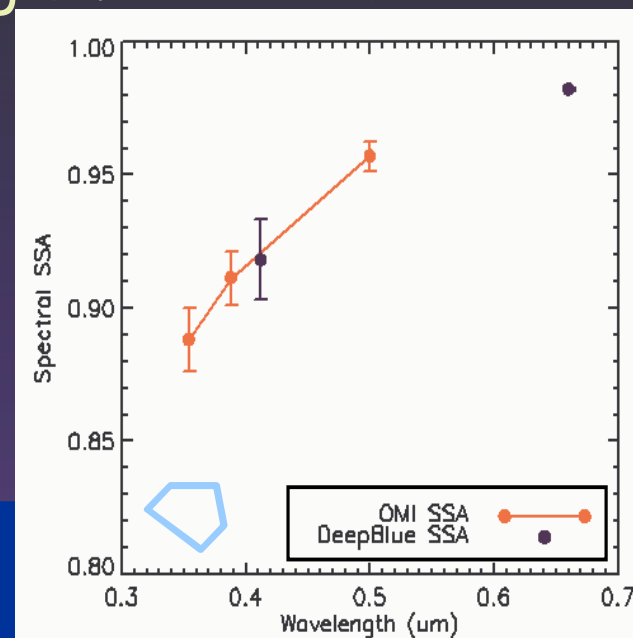
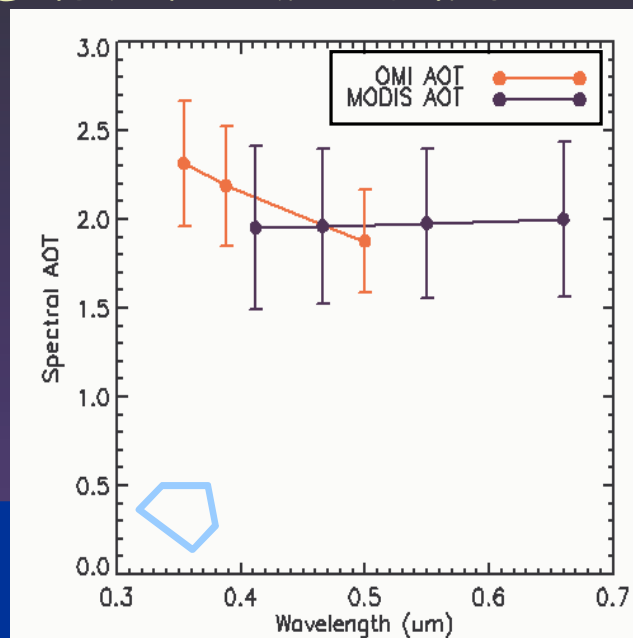
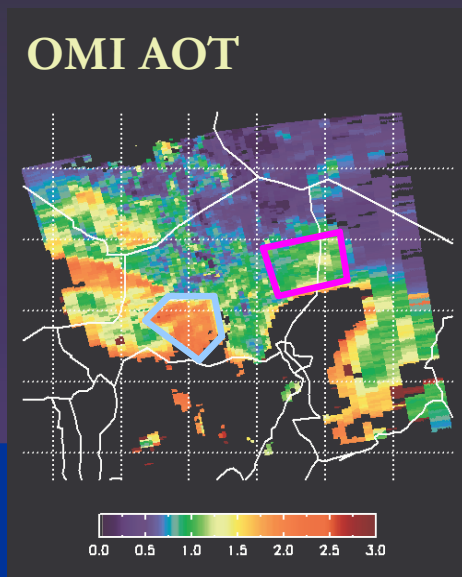
- As higher AF [i.e.,  $(0) \rightarrow (0)+(1) \rightarrow (0)+(1)+(2)$ ] is added, median of OMI AOT slightly shifted toward higher.

- OMI has a tendency of low frequency of  $AOT < 0.5$ .

- For higher AOTs (i.e., important aerosol episodes), OMI and MODIS showed consistency between collocated pixels, regardless of OMI's AF (for  $AF=0,1,2$ ).



# Case 2. Saharan Dust: Near Source Region - Additional Scenes



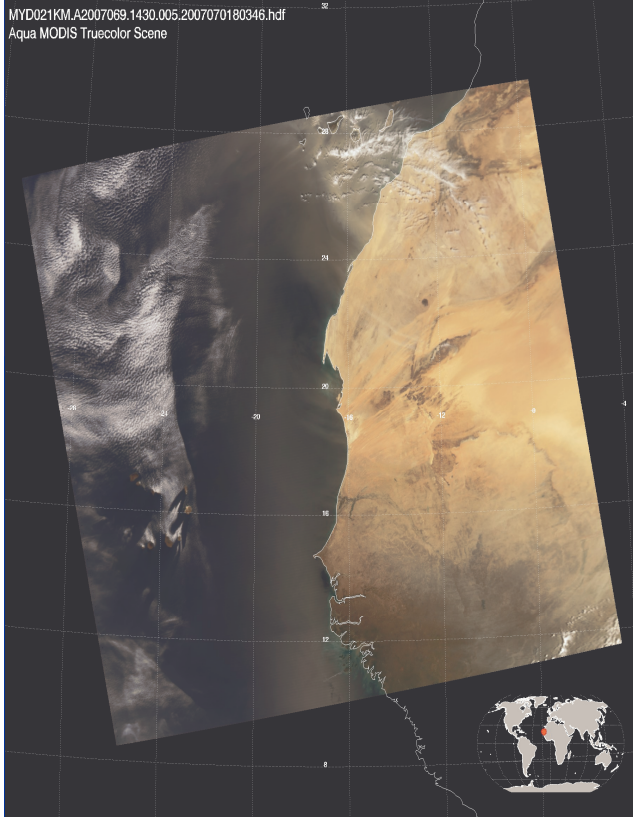
OMI Algor. Flag=0,1,2



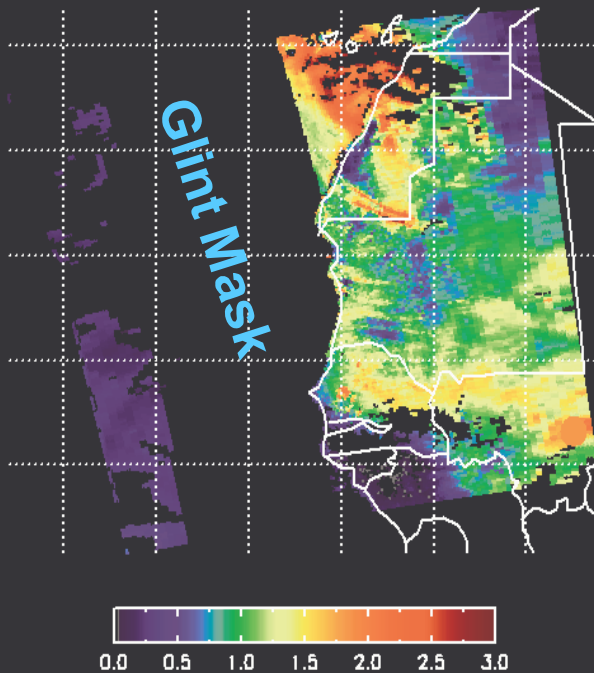
# Case 3. Saharan Dust: Transported

MODIS RGB Image  
Y2007, DoY069, 14:30UTC

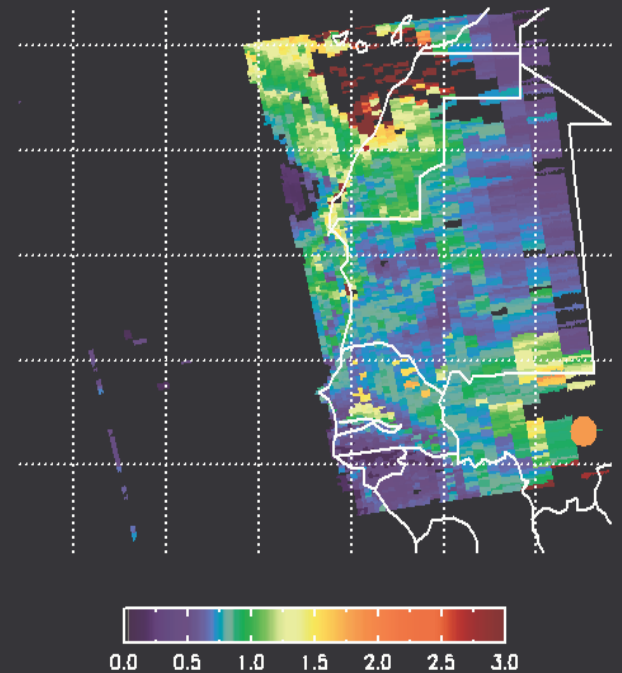
MYD021KM.A2007069.1430.005.2007070180346.hdf  
Aqua MODIS Truecolor Scene



MODIS AOT\* (550nm)



OMI AOT(500nm)



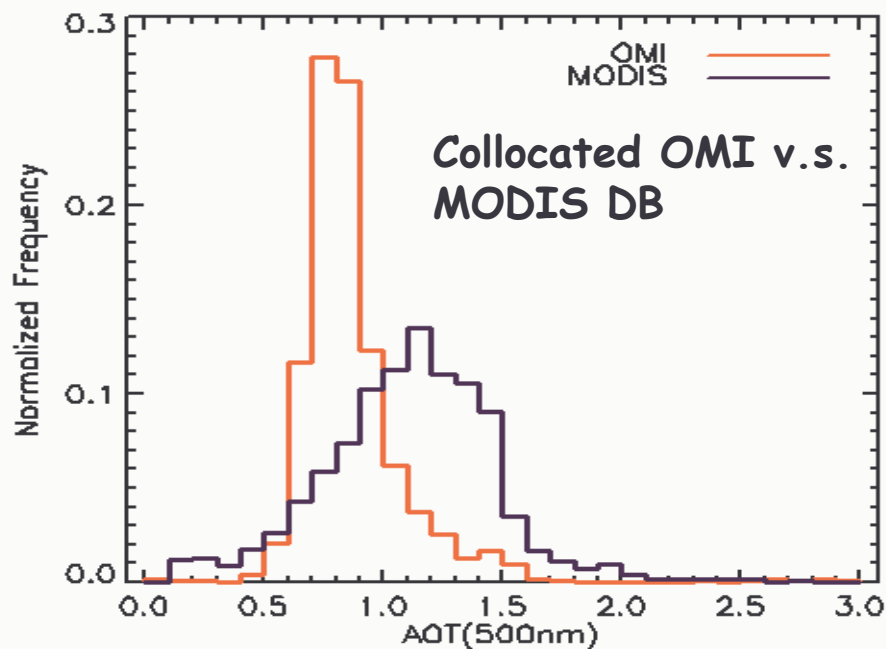
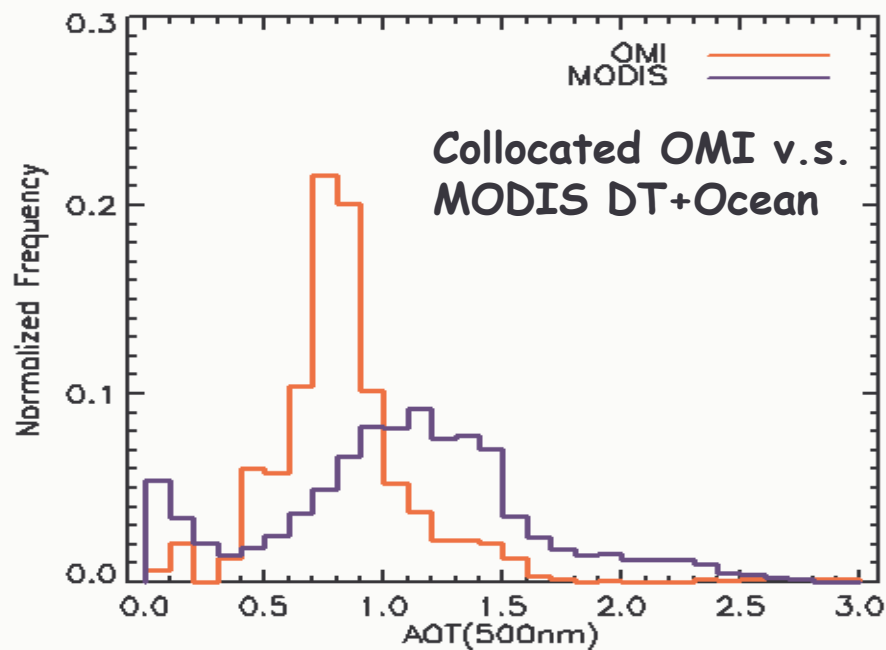
- Continuity along the coastline both in OMI and MODIS AOT
- Smooth transition among MODIS Ocean, Dark Target and Deep Blue AOTs.
- OMI AOT is lower than MODIS AOT for many pixels in this scene.

\*MODIS AOT(550nm) map shown above is composite of Deep Blue, Dark Target, and Ocean retrieval.

## Saharan Dust: Transported (continued)

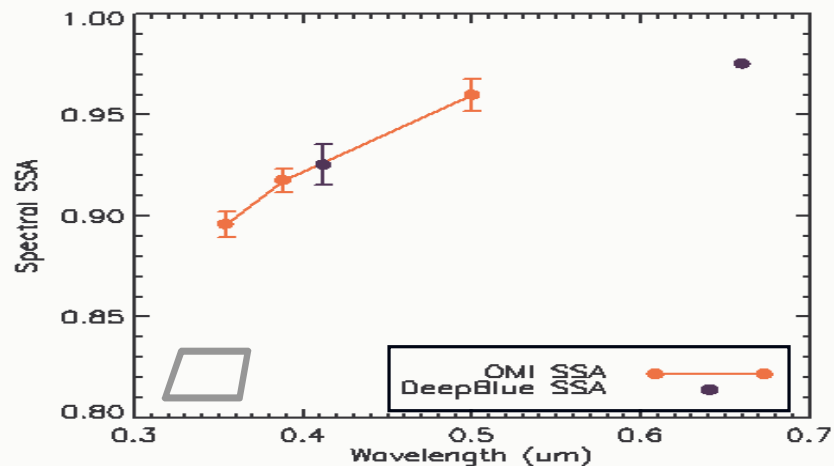
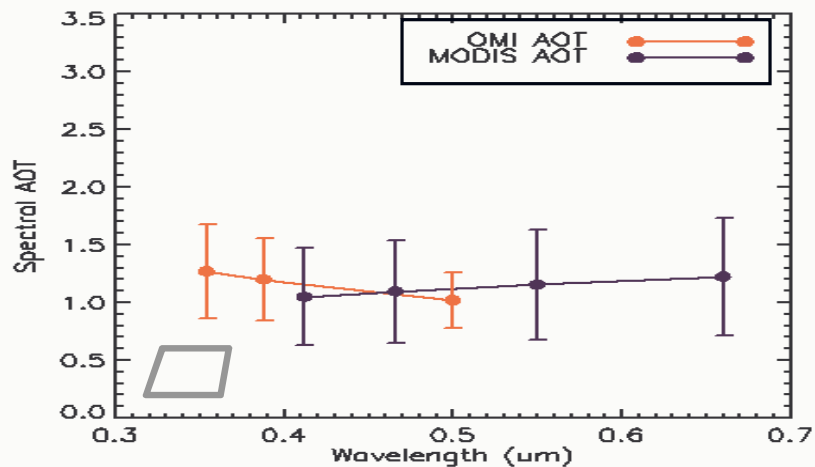
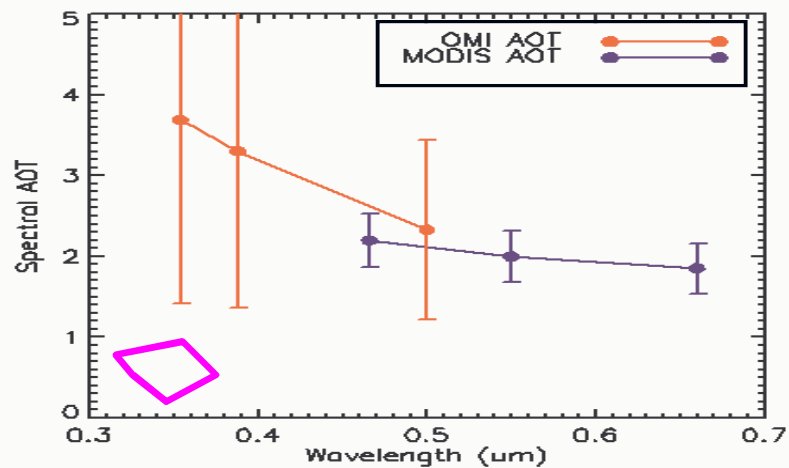
### Granule Statistics Summary

- Histogram for MODIS (Dark Target, Ocean, and Deep Blue) showed broader spectra.
- OMI median is lower than MODIS.
- OMI has lower frequency for low AOT (e.g.,  $AOT < 0.4$ ). → present consistently for all the three cases shown here.

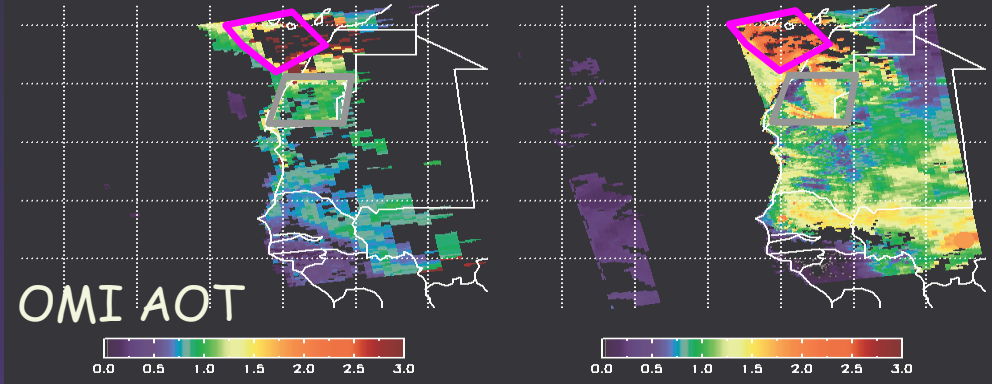


\*MODIS AOT is interpolated at 500nm using Angstrom Exponent.





## Saharan Dust: Transported (continued) MODIS AOT



## Spectral Dependency of AOT and SSA

- OMI v.s. MODIS Ocean  
✓ OMI shows stronger spectral dependency.
- OMI v.s. MODIS Deep Blue  
✓ Both shows rather weak spectral dependency, but with the opposite sign.  
✓ Similar spectral dependency for SSA

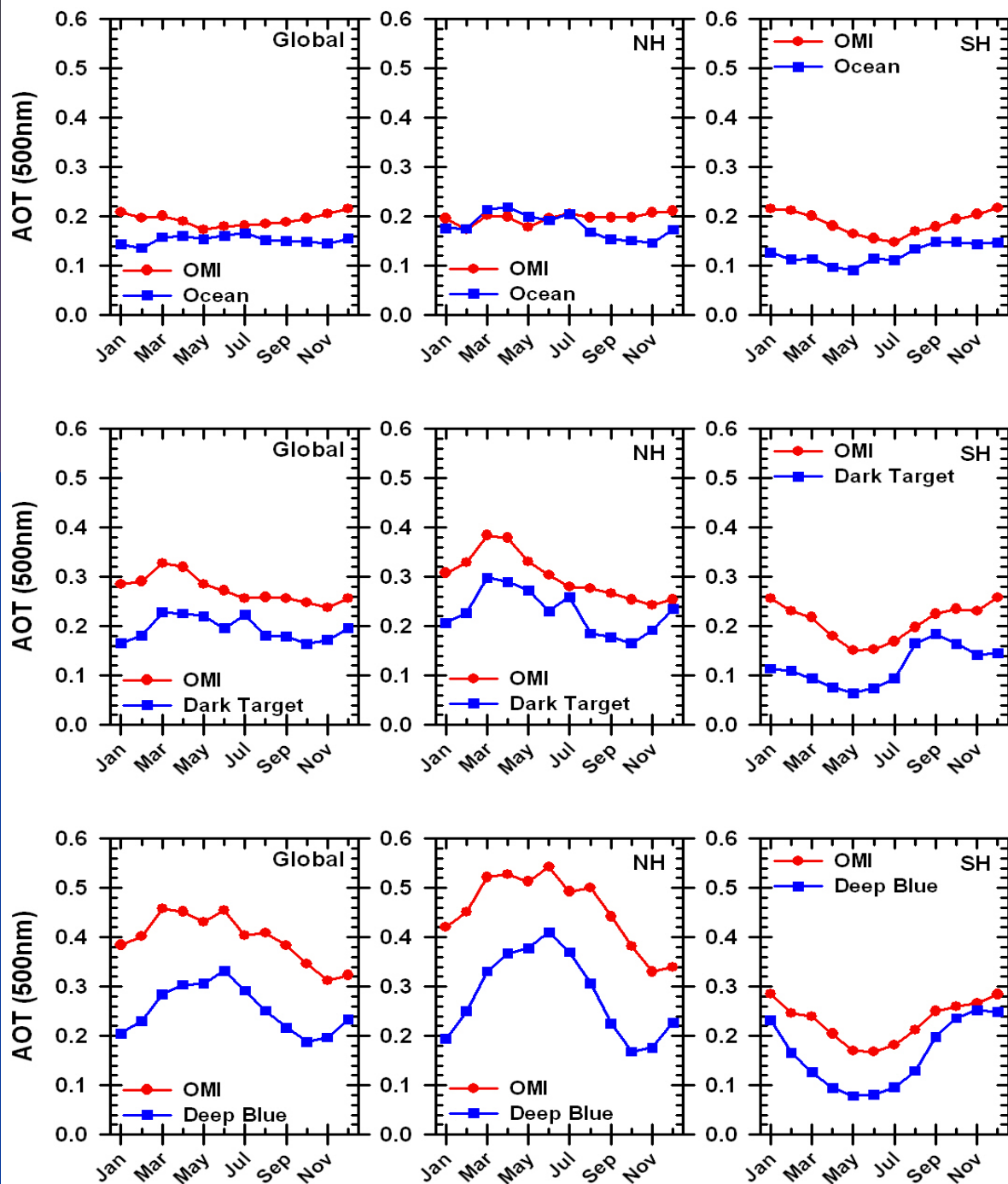
# Monthly Variation of Global and Hemispheric Mean AOT\* (500nm) in 2006

MODIS Ocean v.s. OMI

MODIS Dark Target (Land) v.s. OMI

MODIS Deep Blue (Land) v.s. OMI

\*MODIS AOT is interpolated at 500nm using Angstrom Exponent.



# Summary and Future Work

- Level 2 Data Comparison

- ✓ Similar AOT spatial distribution patterns
- ✓ Clouds are well-screened out for OMI AOT with  $AF=0$
- ✓ Some intensive aerosol episodes are also screened out for OMI AOT with  $AF=0$ , while those can be viewed for OMI AOT with  $AF=0,1,2$ .
- ✓ Spectral dependency of AOT for Asian biomass burning smoke are consistent between OMI and MODIS.
- ✓ Spectral dependency for Saharan dust
  - SSA: Consistent between OMI and MODIS Deep Blue
  - AOT: The opposite spectral signatures are often found.

- Future Work

- ✓ More case studies for other types of aerosols in other regions
- ✓ Inter-comparison for global and regional monthly data
- ✓ Validation against the AERONET data